Digital Wireless

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Packet Radio and Beyond

Broadband Wireless Internet Access and Amateur Radio

In my day job of writing about developments and technology in the Broadband Wireless Internet Access industry, I'm privileged to get to talk to some of the brightest folks I've ever met. As part of my job, I interview Chief Executive Officers, Chief Technical Officers, and lots of people who have marketing and financial backgrounds. Because of the nature of my questions, I'm occasionally asked what my journalism or technical background is. That's when I confess to them that my "foundation" knowledge about wireless data communication stems from my experiences with amateur radio digital communications. That's almost always one they haven't heard before.

Steeped as I am in both amateur radio digital communications and now Broadband Wireless Internet Access, I'm constantly encountering "connections" between the two worlds. The most recent example of this is "mesh networking," one of the latest technologies to emerge in the BWIA industry. Ensuring a full-coverage area, especially at frequencies beginning at 2 GHz, is a challenge, and the BWIA industry has evolved a number of NLOS (Near, or Non Line Of Sight) technologies that help enhance coverage, such as taking advantage of multipath. However, there are plenty of situations in which NLOS simply cannot help. Increasingly, mesh networking is the answer to such coverage issues, and a number of new companies in the BWIA industry are coming out with products that incorporate mesh networking. At a recent conference I interviewed several of these companies and we compared notes about just how many implementations of mesh networking there were currently. My version of that list ran considerably longer than others, and I included in that list amateur radio networking.

I remember vividly the heady days in the late '80s /early '90s when Net/ROM reigned supreme and we seemed well on our way to developing a national network of interconnected nodes. The overall concept of Net/ROM—a wireless network with multiple dynamically formed links—is the essence of mesh networking. Before that, the inherent ability of each Terminal Node Controller (TNC) to act as a relay point (digipeater) or make use of a relay point/digipeater was something we took for granted... but is just now beginning to make its way into common practice in the BWIA and wireless data industries.

There are numerous other examples that space doesn't allow me to delve into, such as

• The elegant short messaging system via internet that's grown to be an integral part of Automatic Position Reporting System (APRS) before the rise of Short Messaging Services (SMS) on mobile phones.

• That the two big dedicated wireless data networks in the US: Cingular Interactive (formerly BellSouth Wireless Data, Mobitex) and Motient (formerly ARDIS) don't offer speeds much greater than 9600 baud, which amateur radio has easily achieved.

• APRS integrating Global Position System (GPS) receivers into "user stations" and transmitting the positioning info, predating such GPS receiver integration into cell phones for positioning info for 911 calls.

• That the innovative Ricochet wireless internet access system (another example of mesh networking often overlooked) was inspired by early Net/ROM networks in California.

• That Dataradio Corporation, which claims to be "a leading designer and manufacturer of advanced wireless data products and systems for mission critical applications" was founded by Montreal amateur radio operators on the basis of the first amateur packet radio experiments.

When I tell people in the BWIA industry about my "foundation" knowledge in amateur radio, I do so absolutely without shame or embarrassment. My amateur radio experience has served me very well, and continues to do so.

In one of the most recent issues of my newsletter, "Focus On Broadband Wireless Internet Access," I wrote about what it takes to begin a Wireless Internet Service Provider. One of the points I made was that RF knowledge is no longer optional. At one point it was possible to learn about RF as you went along. That's simply not the case in 2002; mistakes are too costly in money, time, and customer satisfaction. Amateur radio is one place where you can, in fact, learn RF "on the job." I'm observing a small, but detectable rise in the number of amateurs involved in the Broadband Wireless Internet Access industry and that's no surprise to me. It's a lot easier to teach a person who knows RF about networking than it is to teach a person who knows networking about RF. Extrapolating from a networking background, RF should be easy—just physics, right? RF should be just a different type of network, right? We amateur radio operators know only too well, however, that there's a significant amount of "art" in RF. It's not "just" science.

One last mention about BWIA: In many communities, especially small and rural ones, there's a dearth of broadband internet options. DSL and cable modems are only rarely available. Satellite-based Broadband Internet Access is available, but it has irritating latency and congestion issues. That leaves wireless. If your community doesn't have broadband internet access and you'd be interested in being involved, talk to your local Internet Service Provider. Chances are good that he or she is considering wireless and might need the help of someone who knows RF.

56K Packet Radio

Dale Heatherington, WA4DSY, debuted 56K technology to amateur radio with great fanfare in 1987, and it seemed like the wave of the future. In short order there were numerous add-on developments:

• Gracilis debuted a PC interface card and standalone TCP/IP router intended for use with WA4DSY modems.

• Georgia Radio Amateur Packet Enthusiasts Society (GRAPES) offered the WA4DSY 56K modem kit for sale.

• The Packet Working Group of the Ottawa Amateur Radio Club debuted the Packet Interface (PI) card and later the much improved PI-2 card intended for use with WA4DSY modems.

• The Awesome I/O Card, a high-performance PC interface card, and the PS-186, a high-performance stand-

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alone 4-port TCP/IP switch are described at various Digital Communications Conferences.

• As partial compensation for the loss of 220–222 MHz, the ARRL secures the conditional use of 219–220 MHz for high-speed amateur radio point-to-point links. 219–220 MHz is proposed to be divided into ten 100 kHz channels to allow use of WA4DSK 56K modems.

• 56K repeaters and networks were constructed in Ottawa, QC; Atlanta, GA; Chicago, IL; Vancouver, BC; and perhaps other areas.

In 2002...

• The Gracilis product line was absorbed by PacComm Packet Radio Systems, who ended up not being able to actually sell Gracilis products due to lack of support from Gracilis.

• WA4DSY's cost-reduced, greatly simplified 56K "v2" modem was commercialized by PacComm, who has stated that once current stock is exhausted, WA4DSY modems will be discontinued.

• The Packet Working Group is out of the PI2 card business, the intellectual property given over to TAPR, which has no plans to offer the PI2 as a product.

• The Awesome I/O Card and PS-186 never emerged as actual products.

• I've queried the ARRL several times, and knowledgeable personnel are unable to cite, from actual knowledge, any actual amateur radio use of 219–220 MHz (in fairness, some of the conditions for use make it difficult to use).

• WA4DSY reports that "interest in 56k packet here in the Atlanta area has dropped to zero." A similar situation is reported in for the Vancouver 56K systems. Likely the situation is similar in Chicago and Ottawa, if in fact 56K systems are even still on the air.

Why?

56K was expensive compared to "conventional" packet radio. The 56K modem cost several hundred dollars; not just the commercial version, but even a kit or do-it-yourself project isn't much cheaper. Not only did you need the modem, but you needed a transverter to go from the 28 MHz output of the modem to the band of your choice —another several hundred dollars. Of course, you needed a high-speed 56K interface card; that was relatively cheap at $100 to $200.

The other factor was that WA4DSY's modem required 100 kHz of dedicated bandwidth, so a UHF repeater required a 100 kHz transmit channel and a 100 kHz receive channel. Few urban areas, where the interest was the greatest, had that much vacant adjacent spectrum available. One daunting task in building a 56K repeater was the duplexer; it had to be custom-made to accommodate the 100 kHz channels. Building such a duplexer or financing a commercial custom-made unit was a complex challenge.

56K users just gradually drifted away, and newcomers didn't come to replace them.

In Seattle we're a bit luckier. Dennis Rosenauer, AC7FT/VE7BPE, is an RF Design Engineer working in the Seattle area. Dennis built and installed the two Vancouver 56K repeaters using his own independent design of the WA4DSY 56K modem and a matching synthesized UHF transverter. Dennis noted the lack of use of one of the 56K repeaters (on Sumas) and decided to see if he could find a home for it closer to him in the Seattle area. As of January, the Puget Sound Amateur Radio TCP/IP Group (which prefers to be known as "the WetNET Group") has tentatively identified a temporary location for the 56K repeater, and perhaps

sufficient vacant spectrum on UHF in which to operate it. (The WetNET Group's newly revised web page is now online at <http://www.seatcp.net>.)

Finding 56K equipment, given the situation outlined above, will be a bit of a challenge. The biggest challenge is the issue of interface cards. I'll provide updates the Seattle 56K repeater project evolves.

802.11

I've written several times about 802.11b (11 Mbps), also known as "Wi-Fi," equipment and that I think amateur radio operators should be working to familiarize themselves with 802.11b. Don't think "limited range RF"; think "Ethernet cable and hub, without the hassle of wires." Hams use Ethernet cable all the time now.... they shouldn't be intimidated by 802.11b.

I haven't seen any 802.11b equipment that I was the least bit tempted to recommend to hams to become familiar with 802.11b... until now.

The Linksys (<www.linksys.com>) WAP11 meets most of my criteria for what's needed in an 802.11 system hams would be interested in:

- It's inexpensive at $100 to $200. Watch for sales at CompUSA, Office Depot, etc.
- It has non-integral antennas. The rubber-duck antennas are on connectors.
- It has a hub *and* a client mode (most 802.11 access points are hubs only).

The WAP11 has some issues that you should be aware of:

- Linksys's reputation for support is terrible (but the community support for the WAP-11 is very good). If a WAP11 has problems out of warranty, there's no repair-for-fee offered. You simply have to buy a new one.
- It can be tough to configure; you might be in for a frustrating experience, especially if you're not a Windows user.
- In "client" mode, the WAP11 will *only* communicate another WAP11 (running in access point mode). Apparently, the "client" communication is implemented in a proprietary way.
- There's no repeater (hams would call it digipeater) mode (although

The 2002 Digital Communications Conference

This information is slightly in advance of the actual, blessed press release, but the essentials won't change.

The 21st Annual ARRL and TAPR Digital Communications Conference will be held September 13–15, 2002 at the Denver Marriott Southeast Hotel, 6363 East Hampden Avenue, Denver, CO 80222 (303-758-7000, <www.marriott.com>). Mark your calendar and start making plans to attend the premier technical conference of the year.

The conference is an international forum for radio amateurs to meet, publish their work, and present new ideas and techniques. Presenters and attendees will have the opportunity to exchange ideas and learn about recent hardware and software advances, theories, experimental results, and practical applications. Topics include, but are not limited to, software-defined radio (SDR), digital voice, digital satellite communications, spread spectrum, global position system, Automatic Position Reporting System (APRS), Precise Timing, HF digital modes, and Digital Signal Processing (DSP). To which I add the following:

- Sort messaging (a mode of APRS)
- Internet interoperability with amateur radio networks
- Mesh/peer-to-peer wireless networking
- Amateur radio use of 802.11 technologies
- Emergency/Homeland Defense backup digital communications
- Examples of commercial wireless digital communications practice that are applicable to amateur radio communications
- Using TCP/IP networking over amateur radio
- Use of Linux in amateur radio
- Updates on AX.25 and other wireless networking protocols.

The conference is for all levels of technical experience, not just for the expert. Not only is the conference technically stimulating, it is a weekend of fun for all who have more than a casual interest in any of the amateur digital communications.

This is a must-attend conference. Now, more than ever, amateur radio needs this great meeting of the minds to demonstrate a continued need for the frequency allocations we now have by pushing forward and documenting our achievements. The conference is the best way to record our accomplishments and challenge each other to do more. This is where the radio art is advanced!

Technical papers are solicited for presentation at the meeting and publication in the annual conference proceedings published by the ARRL. Presentation at the conference is not required for publication. Submission of papers is due by August 5, 2002.

Registration details and updates are available at <http://www.tapr.org/dcc>.

Linksys continues to update WAP11 firmware, so a repeater mode isn't out of the question).

In practice, what makes the WAP11 so interesting is most 802.11b devices are either Access Points *or* clients, but not both. Most client 802.11b devices are PC cards for laptops or slot cards for desktops. It's relatively rare to have an 802.11b Access Point, with the ability to remote it via Ethernet cable and the ability to use external antennas that can function in client mode. Two WAP11s can form an inexpensive, high-speed, short-range link with one WAP11 configured as an access point and the other as a client. You can also form a network with one WAP11 configured as an access point (in a high-profile location, much like a repeater or digipeater would be), and a number of WAP11s configured as clients connecting to the access point.

The Big Gotcha

Modifying a Part 15 device, even attaching external antennas, is a violation of FCC Part 15 rules. A Part 15 certification is certification for the *system*, not just the "radio." Modifications void the "implied license for this device to transmit." "Amateur radio" modification of a Part 15 device is permitted, *if* you are able to modify the device in such a way that transmissions are restricted to the amateur radio segment of the 2.4 GHz band. Since Linksys has not, and likely will not, release detailed enough information to be able to make such a change, "pure" amateur radio use of this device doesn't seem likely. In any case, before considering modifications, I recommend a thorough reading of the FCC Part 15.247 rules.

One of the best writeups on the WAP-11 is at the website: <http://www.practicallynetworked.com/reviews/linksys_wap11.asp>.

In Closing . . .

I *highly* recommend attending the 2002 Digital Communications Conference. Last year's DCC was a subdued affair (but still quite lively and interesting) in the aftermath of the events of 9/11/01. If you're reading this column and find it the least bit interesting, then you'll thoroughly enjoy attending the DCC, even if you have to go to some expense to travel there. It's total immersion in the technical aspects of amateur radio digital communications. You get to meet fascinating people doing fascinating things.

Because the DCC travels to different parts of North America each year, you get to meet different groups of people. One of the most memorable DCCs I attended was held in Colorado Springs, CO, where I met one of my personal heroes, Bdale Garbee, N3EUA, author of the very popular "Bits In The Basement" column in the TAPR "Packet Status Register" newsletter, on which I've mentally modeled this column on more than one occasion.

Space, and more important, time, is up for this column. In my next column I hope to tell you about:

- The Seattle Software Radio Project.
- My idea for a Wireless ISP Smart Radio and how it relates to amateur radio.
- A "repeater grade" 802.11b Access Point that could form the basis of an 802.11b network with long range.
- A line of high-speed radios and TNC-like devices from Germany (<http://www.symek.com/g/index-g.html> if you want to peek), and my impressions of their product line in the face of what has happened to 56K packet radio in the US.

73, and please write!
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